Enhanced MgF_2 and LiF Over-coated Al Mirrors for FUV Space Astronomy

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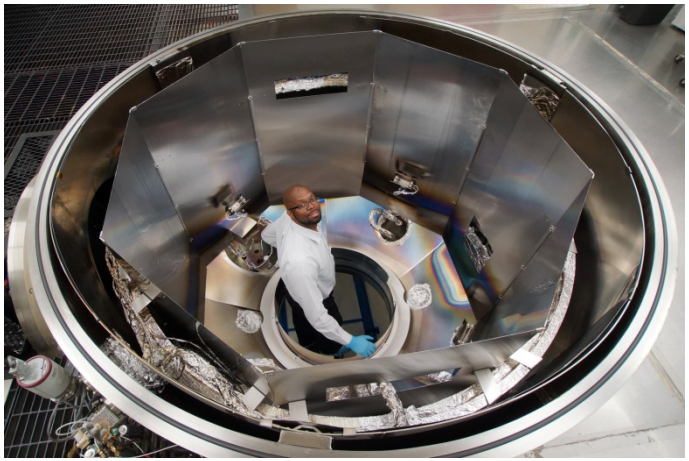
Description and Objectives:

- To develop on a large scale (up to 1 meter diameter) coating of mirrors using a Al+MgF_2 coating process to enhance performance in the Far-Ultraviolet spectral range
- Study other dielectric fluoride coatings and other deposition technologies such as Ion Beam Sputtering (IBS) that is known to produce the nearest to ideal morphology optical thin film coatings and thus low scatter

Key Challenge/Innovation:

- Improved reflective coatings for large optics, particularly in the ultraviolet part of the spectrum, could yield dramatically more sensitive instruments and permit more instrument design freedom



Inside 2-meter coating chamber after installation of thermal shroud and halogen-quartz heater lamps.

Approach:

- Retrofit a 2 meter coating chamber with heaters/thermal shroud to perform coating iterations at a high deposition temperatures (200-300°C) to further improve performance of protected Al mirrors with either MgF_2 or LiF overcoats
- Optimize deposition process of lanthinide trifluorides as high-index materials that when paired with either MgF_2 or LiF will enhance reflectance of Al mirrors at Lyman-alpha
- Establish the IBS coating process to optimize deposition of MgF_2 and LiF with extremely low absorptions at FUV wavelengths

Key Collaborators:

- Steve Rice and Felix Threat (551)
- John Lehan (SGT)
- Jeff Kruk and Charles Bowers (665)

Development Period:

- FY12 – FY14

Accomplishments and Next Milestones:

- Established the short wavelength transmission cutoff of GdF3 and LuF3 films grown by physical vapor deposition method.
- Systematic study of MgF_2 films grown with the IBS process as function of growth temperature and other coating parameters.
- Re-optimized the growth process of Al+MgF_{2+} to realize additional reflectance gains below 1200 A.
- Initial coating run of Al+MgF_2 slide distribution in 2 meter chamber: August 2013
- Design and fabricate a narrow-wavelength reflector using a dielectric stack in the 1200-1500A range: November 2013

Application:

- This technology will enable FUV missions to investigate the formation and history of planets, stars, galaxies and cosmic structure, and how the elements of life in the universe arose

TRLin = 4 ***TRLcurrent = 4*** ***TRLtarget = 5***